



UNIVERSITI PUTRA MALAYSIA

**COMPARATIVE STUDIES ON GANODERMA (KARST.) FROM
INFECTED OIL PALM AND COCONUT STUMPS WITH
SPECIAL REFERENCE TO THEIR MORPHOLOGICAL,
MOLECULAR AND ISOZYME CHARACTERISTICS**

LATIFFAH ZAKARIA

IB 2002 1

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By

LATIFFAH ZAKARIA

**Thesis Submitted in Fulfilment of the Requirement for the Degree of
Doctor of Philosophy in the Institute of Bioscience
Universiti Putra Malaysia**

January 2002



Abstract of the thesis submitted to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Doctor of Philosophy

**A COMPARATIVE STUDY ON *GANODERMA* (KARST.) FROM
INFECTED OIL PALM AND COCONUT STUMPS WITH SPECIAL
REFERENCE TO THEIR MORPHOLOGICAL, MOLECULAR AND
ISOZYME CHARACTERISTICS**

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January 2002

Chairman: Prof. Dr. Ho Yin Wan

Faculty: Institute of Bioscience

The basal stem rot of oil palm caused by *Ganoderma* is the most serious disease infecting oil palm in South-east Asia. It is believed that coconut stumps which are colonized by *Ganoderma* can act as sources of inoculum for infection to healthy palms through root contact. However, it is not known whether the *Ganoderma* infecting oil palm and those colonizing coconut stumps are the same species. Therefore, a comparative study was conducted to determine the similarities and differences between *Ganoderma* isolates from infected oil palm and coconut stumps, using a multidisciplinary approaches in which morphological, biochemical (intracellular and extracellular enzyme systems) and molecular characteristics (RAPD, RAMS, RFLP and direct sequencing of the ITS regions + 5.8S gene of rDNA) were analysed.

Based on the morphological characteristics of the basidiomata, *Ganoderma* from infected oil palm and coconut stumps conformed to the description of *G. boninense* in Steyaert's classification system for *Ganoderma* (1967 and 1975). The growth on various media and at different temperatures, and the cultural characteristics of the isolates from infected oil palm and coconut stumps were similar with no significant difference observed between the two groups of *Ganoderma*. However, the isolates were somatically incompatible with one another, which indicated that they were genotypically distinct individuals and not clones of a genotypic individual.

The isozyme profiles from intracellular and extracellular enzyme systems, and the DNA profiles from RAPD, RAMS and RFLP of the ITS regions + 5.8S gene revealed that *Ganoderma* isolates from infected oil palm and coconut stumps were very variable. Nucleotide sequences of the ITS regions + 5.8S gene of rDNA from a limited number of isolates also showed that the isolates from both groups of *Ganoderma* were very variable. The Southern hybridization of RAMS gel showed that labelled probes from oil palm and coconut hybridized to the common bands of 1.2 kb by from primer (CGA)₅ and 1.4 kb band by primer (ACA)₅ which indicated that the bands of the same molecular sizes are likely to be homologous.

Cluster analysis based on data from biochemical and molecular characters, and phylogenetic analysis of the nucleotide sequence showed that the oil palm isolates and the coconut isolates did not cluster separately which indicated that isolates of both groups of *Ganoderma* are closely related.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

**KAJIAN PERBANDINGAN *GANODERMA* (KARST.) DARIPADA
KELAPA SAWIT DAN TUNGGUL KELAPA MENGGUNAKAN CIRI-
CIRI MORFOLOGI, MOLEKUL DAN ISOZIM**

Oleh

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Penyakit reput pangkal batang yang disebabkan oleh kulat *Ganoderma* merupakan penyakit yang paling serius menjangkiti pokok-pokok kelapa sawit di Asia Tenggara. Penyakit ini dipercayai berjangkit daripada tunggul kelapa di mana ianya sebagai sumber inokulum, boleh menjangkiti pokok-pokok kelapa sawit yang sihat melalui persentuhan akar. Walaubagaimanapun, tidak diketahui samada *Ganoderma* yang menjangkiti kelapa sawit dan yang terdapat pada tunggul kelapa terdiri daripada spesis yang sama. Oleh itu, satu kajian perbandingan telah dijalankan untuk mengenalpasti persamaan dan perbezaan di antara isolat-isolat *Ganoderma* daripada kelapa sawit dan tunggul kelapa menggunakan pelbagai kaedah seperti ciri-ciri morfologi basidiomata, biokimia (menggunakan sistem enzim intrasel dan ekstrasel) dan molekul (menggunakan analisis RAPD, RAMS, RFLP dan jujukan 'ITS region + gen 5.8S').

Berdasarkan ciri-ciri morfologi basidiomata, didapati ciri-ciri *Ganoderma* daripada kelapa sawit dan tunggul kelapa menyerupai ciri-ciri *G. boninense* yang terdapat pada sistem klasifikasi *Ganoderma* oleh Steyaert (1967 dan 1975). Pertumbuhan miselium pada pelbagai media dan suhu, serta ciri-ciri kultur pertumbuhan isolat-isolat kelapa sawit dan kelapa menunjukkan persamaan dimana tiada perbezaan yang bererti di antara kedua-dua kumpulan *Ganoderma* tersebut.

Profil isozim daripada sistem enzim intrasel dan ekstrasel dan profil DNA daripada analisis RAPD, RAMS, RFLP dan jujukan 'ITS regions + gen 5.8S', menunjukkan terdapatnya variasi pada isolat-isolat kelapa sawit dan kelapa. Variasi juga dapat dilihat pada jujukan 'ITS regions + gen 5.8S' pada beberapa isolat kelapa sawit dan kelapa. 'Southern Hybridization' dari gel analisis RAMS menunjukkan probe daripada kelapa sawit dan kelapa menghibridasi kepada jalur-jalur yang mempunyai size molekul yang sama iaitu jalur 1.2 kb daripada primer (CGA)₅ dan jalur 1.4 kb daripada primer (ACA)₅, menunjukkan jalur yang mempunyai size molekul yang sama adalah homologus .

Analisis cluster daripada kaedah pencirian biokimia dan molekular, serta analisa filogenetik jujukan DNA menunjukkan isolat-isolat kelapa sawit dan kelapa tidak berkelompok secara berasingan. Oleh itu, daripada analisis cluster isolat-isolat *Ganoderma* daripada kelapa sawit dan kelapa mempunyai hubungan yang rapat.

ACKNOWLEDGEMENTS

I wish to express my sincere thanks and gratitude to the chairman of the supervisory committee, Prof. Dr. Ho Yin Wan, for her invaluable advice, guidance, constant encouragement and endless support throughout the duration of the study, and for her critical comments and constructive suggestions during the preparation of my thesis.

I also wish to express my appreciation and sincere gratitude to the supervisory committee members, Prof. Dr Tan Soon Guan, Dr. Faridah Abdullah and Prof. Madya Dr. Harikrishna Kulaveerasingam for their advice, guidance and helpful suggestions throughout the course of my study and in the preparation of my thesis.

I am also grateful to Encik Khairudin Hashim and En. Suzaini from Golden Hope Plantations Berhad for their kind assistance in collecting *Ganoderma* fruiting bodies in the field and for providing some of the stock cultures.

My heartfelt appreciations are extended to my colleagues and staff at the Institute of Bioscience, particularly, Lee Weng Wah, Dr. Faridah Qamarruzaman and Dr. Tan Siang Hee from Genome Centre for their advice and assistance in analyzing the sequence data; and Khairul Kamar Bakri, Madam Haw Ah Kam and Jivanathan Arumugam from the Digestive Microbiology Centre for their technical assistance and co-operation.

To my post-graduate friends at the Digestive Microbiology Centre, Kala, Vicky, Pak Darlis, Chin Chin, Wan, Lee, Thongsuk, and Sidieg, thank you for your friendship, support and laughter which contributed to the successful accomplishment of this work

Finally, very special thanks are due to my family, Abah, Cik, Acun, Kema, for their constant support, encouragements, understanding and sacrifices which inspired and motivated me during the duration of my study.

I certify that an Examination Committee met on 7th January 2002 to conduct the final examination of Latiffah bt. Zakaria on her Doctor of Philosophy thesis entitled “Comparative Studies on *Ganoderma* (Karts.) from Infected Oil Palm and Coconut Stumps with Special Reference to their Morphological, Molecular and Isozyme Characteristics” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



LATIFFAH BT. ZAKARIA

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